

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1-20. (Cancelled)

21. (currently amended) The detection control circuit according to claim 2024 or 26, wherein said measurement circuit segment measures a frequency of the residual vibration of the detection device.

22. (currently amended) The detection control circuit according to claim 2024 or 26, wherein said measurement circuit segment measures at least one resonance frequency of the liquid surrounding the detection device.

23. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

a measurement circuit segment for measuring a residual vibration of the detection device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

wherein said measurement circuit segment measures a counter-electromotive voltage generated by the detection device in accordance with the residual vibration thereof.

24. (currently amended) ~~The detection control circuit according to claim 20, A~~
detection control circuit for detecting a consumption status of liquid contained in a liquid
container by a detection device having a piezoelectric element, the detection device comprising
an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit
comprising:

a measurement circuit segment for measuring a residual vibration of the detection
device; and

a detection circuit segment receiving a signal from said measurement circuit segment
and outputting a signal indicative of the consumption status of the liquid contained in the liquid
container on the basis of the output signal of said measurement circuit segment,

wherein said measurement circuit segment comprises an amplifier, said amplifier
comprises a PNP type transistor and a NPN type transistor which complementarily connecting
with said PNP type transistor, and emitter of said PNP type transistor and an emitter of said NPN
type transistor connect with each other.

25. (Original) The detection control circuit according to claim 24, wherein a drive
voltage generated between a point connecting between the emitter of said NPN type transistor
and said PNP type transistor and the ground is applied to the detection device.

26. (currently amended) ~~The detection control circuit according to claim 20, A~~
detection control circuit for detecting a consumption status of liquid contained in a liquid
container by a detection device having a piezoelectric element, the detection device comprising
an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit
comprising:

a measurement circuit segment for measuring a residual vibration of the detection
device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment.

wherein said measurement circuit segment comprises an amplifier, said amplifier comprises a P-channel field effect transistor and a N-channel field effect transistor which complementarily connecting with said P-channel field effect transistor, and a source of said P-channel transistor and a source of said N-channel transistor connect with each other.

27. (Original) The detection control circuit according to claim 26, wherein a drive voltage generated between a point connecting between the sources of said N-channel FET and said P-channel FET and the ground is applied to the detection device.

28. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

a measurement circuit segment for measuring a residual vibration of the detection device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

wherein said detection circuit segment comprises a counter for counting number of the vibration of the residual vibration within a predetermined time period, and said detection circuit segment judges the liquid consumption status in accordance with the counted value.

29. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric

element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

- a measurement circuit segment for measuring a residual vibration of the detection device; and

- a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

- wherein said detection circuit segment comprises a counter for counting number of clock pulses within a time period where the residual vibration vibrates a predetermined number of times, said clock has a cycle shorter than the vibration cycle of the residual vibration.

30. (Original) The detection control circuit according to claim 28 or 29, wherein said detection circuit starts counting the number of vibration of the residual vibration after a predetermined number of vibrations of the residual vibration has occurred.

31. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

- a measurement circuit segment for measuring a residual vibration of the detection device; and

- a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

- wherein said detection circuit segment outputs a signal representing whether the liquid container connects with said measurement circuit.

32. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

a measurement circuit segment for measuring a residual vibration of the detection device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

wherein said measurement circuit segment further comprises a plurality of amplifiers connecting with a respective one of a plurality of the detection devices to supply a drive voltage, and said detection circuit segment receives a plurality of signals from said measurement circuit segment corresponding to the respective detection device and outputting a plurality of signals indicative of the consumption status of the liquid contained in the liquid container on the basis of each of the output signals of said measurement circuit segment.

33. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

a measurement circuit segment for measuring a residual vibration of the detection device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

further comprising a control circuit segment for controlling an operation to consume the liquid contained in the liquid container in accordance with the output signal of said detection circuit segment.

34. (Previously Presented) A detection control circuit for detecting a consumption status of liquid contained in a liquid container by a detection device having a piezoelectric element, the detection device comprising an actually vibrating part facing a cavity which defines the vibration of the liquid, the circuit comprising:

a measurement circuit segment for measuring a residual vibration of the detection device; and

a detection circuit segment receiving a signal from said measurement circuit segment and outputting a signal indicative of the consumption status of the liquid contained in the liquid container on the basis of the output signal of said measurement circuit segment,

wherein said control circuit segment comprises an information memory control circuit segment for reading out the liquid consumption status stored in a memory device attached to the liquid container and writing in the memory device information relating to the liquid consumption status detected by said detection circuit segment.

35-44. (Cancelled)

45. (currently amended) The detection control circuit according to claim 2024 or 26, wherein the liquid container is an ink cartridge for an ink-jet type printing apparatus.

46. (currently amended) The detection control circuit according to claim 2024 or 26, wherein a node of the vibration of the detection device is located on the periphery of the cavity.

47. (currently amended) The detection control circuit according to claim 2024 or 26, wherein at least a part of said vibrating part contacts the liquid in the liquid container.

48. (currently amended) The detection control circuit according to claim 2024 or 26, wherein the depth of said cavity is smaller than the narrowest width of said cavity.

49. (previously presented) The detection control circuit according to claim 48, wherein a ratio of a radius of said cavity with a depth thereof is larger than $3\pi/8$.

50. (previously presented) The detection control circuit according to claim 48, wherein the depth of said cavity is less than one-third of the narrowest width of said cavity.

51. (currently amended) The detection control circuit according to claim ~~20~~24 or 26, wherein said detection device comprises a base member at which said cavity is formed, and the compliance of said vibrating part is greater than that of said base member.

52. (new) The detection control circuit according to claim 23, wherein said measurement circuit segment measures a frequency of the residual vibration of the detection device.

53. (new) The detection control circuit according to claim 23, wherein said measurement circuit segment measures at least one resonance frequency of the liquid surrounding the detection device.

54. (new) The detection control circuit according to claim 23, wherein said measurement circuit segment comprises an amplifier, said amplifier comprises a PNP type transistor and a NPN type transistor which complementarily connecting with said PNP type transistor, and emitter of said PNP type transistor and an emitter of said NPN type transistor connect with each other.

55. (new) The detection control circuit according to claim 54, wherein a drive voltage generated between a point connecting between the emitter of said NPN type transistor and said PNP type transistor and the ground is applied to the detection device.

56. (new) The detection control circuit according to claim 23,
wherein said measurement circuit segment comprises an amplifier, said amplifier comprises a P-channel field effect transistor and a N-channel field effect transistor which complementarily connecting with said P-channel field effect transistor, and a source of said P-channel transistor and a source of said N-channel transistor connect with each other.

57. (new) The detection control circuit according to claim 56, wherein a drive voltage generated between a point connecting between the sources of said N-channel FET and said P-channel FET and the ground is applied to the detection device.

58. (new) The detection control circuit according to claim 23,
wherein said detection circuit segment comprises a counter for counting number of the vibration of the residual vibration within a predetermined time period, and said detection circuit segment judges the liquid consumption status in accordance with the counted value.

59. (new) The detection control circuit according to claim 23,
wherein said detection circuit segment comprises a counter for counting number of clock pulses within a time period where the residual vibration vibrates a predetermined number of times, said clock has a cycle shorter than the vibration cycle of the residual vibration.

60. (new) The detection control circuit according to claim 23, wherein said detection circuit starts counting the number of vibration of the residual vibration after a predetermined number of vibrations of the residual vibration has occurred.

61. (new) The detection control circuit according to claim 23,
wherein said detection circuit segment outputs a signal representing whether the liquid container connects with said measurement circuit.

62. (new) The detection control circuit according to claim 23,
wherein said measurement circuit segment further comprises a plurality of amplifiers connecting with a respective one of a plurality of the detection devices to supply a drive voltage, and said detection circuit segment receives a plurality of signals from said measurement circuit segment corresponding to the respective detection device and outputting a plurality of signals indicative of the consumption status of the liquid contained in the liquid container on the basis of each of the output signals of said measurement circuit segment.

63. (new) The detection control circuit according to claim 23,
further comprising a control circuit segment for controlling an operation to consume the liquid contained in the liquid container in accordance with the output signal of said detection circuit segment.

64. (new) The detection control circuit according to claim 23,
wherein said control circuit segment comprises an information memory control circuit segment for reading out the liquid consumption status stored in a memory device attached to the liquid container and writing in the memory device information relating to the liquid consumption status detected by said detection circuit segment.

65. (new) The detection control circuit according to claim 23, wherein the liquid container is an ink cartridge for an ink-jet type printing apparatus.

66. (new) The detection control circuit according to claim 23, wherein a node of the vibration of the detection device is located on the periphery of the cavity.

67. (new) The detection control circuit according to claim 23, wherein at least a part of said vibrating part contacts the liquid in the liquid container.

68. (new) The detection control circuit according to claim 23, wherein the depth of said cavity is smaller than the narrowest width of said cavity.

69. (new) The detection control circuit according to claim 68, wherein a ratio of a radius of said cavity with a depth thereof is larger than $3\pi/8$.

70. (new) The detection control circuit according to claim 68, wherein the depth of said cavity is less than one-third of the narrowest width of said cavity.

71. (new) The detection control circuit according to claim 23, wherein said detection device comprises a base member at which said cavity is formed, and the compliance of said vibrating part is greater than that of said base member.